Unconsolidated Aquifer Systems of Jefferson County, Indiana

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Four unconsolidated aquifer systems have been mapped in Jefferson County: the Dissected Till and Residuum; the Alluvial, Lacustrine, and Backwater Deposits; the Pre-Wisconsin Drift; and the Ohio River Outwash. The first system includes relatively thin deposits left by continental ice sheets as well as eroded residuum (a product of bedrock weathering). The next three systems comprise sediments deposited by, or resulting from, glaciers, glacial meltwaters, and post-glacial precipitation events. Boundaries of these aquifer systems are commonly gradational and individual aquifers may extend across aquifer system boundaries. However, a relatively distinct boundary occurs where the Ohio River Outwash Aquifer System abuts the steep rocky hillsides of the Dissected Till and Residuum Aquifer System.

Outside of the main valley of the Ohio River, nearly the entire county has less than 25 feet of unconsolidated materials overlying the bedrock. Bedrock outcrops are especially common in the eastern half of the county. However, a few scattered areas in northwestern Jefferson County contain unconsolidated materials exceeding 50 feet in thickness. Most unconsolidated deposits contain some sand or gravel. However, only within the main valley of the Ohio River are the sand and gravel deposits of sufficient thickness and extent to constitute major ground-water resources capable of supplying large municipal, industrial, and irrigation needs.

Regional estimates of aquifer susceptibility to contamination from the surface can differ considerably from local reality. Variations within geologic environments can cause variation in susceptibility to surface contamination. In addition, man-made structures such as poorly constructed water wells, unplugged or improperly abandoned wells, and open excavations can provide contaminant pathways that bypass the naturally protective clays.

Dissected Till and Residuum Aquifer System

The Dissected Till and Residuum Aquifer System, which covers about 97 percent of Jefferson County, has the most limited ground-water resources of all the unconsolidated aquifer systems in the county. In most of the county the aquifer system is so thin that it is not seriously considered as a source of water. The unconsolidated materials of this aquifer system consist primarily of eroded bedrock residuum and limited amounts of pre-Wisconsin glacial till and loess on the broad uplands and hillsides. Also included in many of the stream valleys are relatively thin deposits of alluvium, colluvium, and lacustrine materials. In the eastern half of the county the stream bottoms are noted for having rock outcrops and pieces of broken limestone and other materials ranging in size from large slabs to gravel, sand, silt, and clay. Overall, the unconsolidated materials of this aquifer system are relatively high in clay and silt content. In scattered places a thin sand layer is noted. The total thickness of the Dissected Till and Residuum Aquifer System in Jefferson County typically ranges from about 5 to 25 feet.

Unconsolidated materials above the bedrock are so thin in most places that the aquifer elevations roughly approximate the elevations of the bedrock surface. The bedrock surface elevations in the areas of this aquifer system range irregularly from about 450 feet above mean sea level (m.s.l.) near the Ohio River at the south county line to about 950 feet m.s.l. on uplands in the northeastern corner of the county. Static water levels in the few wells for which the Division has records range from about 6 to 17 feet below land surface.

Due to the thinness of the aquifer system, dry holes are common. A few dug wells are likely still used, but their yields would typically be quite low. The majority of newer wells drilled in this system would typically be large-diameter bored (bucket-rig) wells. The 3 bored wells for which the Division has records have been tested at 0.5 to 1 gallon per minute (gpm). Potential yields of conventionally drilled wells are generally known to be so small that most drillers in this area prefer to complete wells in the underlying bedrock.

Because of the low permeability of the surface materials, this system is not very susceptible to surface contamination.

Alluvial, Lacustrine, and Backwater Deposits Aquifer System

The Alluvial, Lacustrine, and Backwater Deposits Aquifer System is composed of unconsolidated deposits in a few larger valleys tributary to the Ohio River. The unconsolidated deposits primarily come from two sources. One source is alluvium, and perhaps some old outwash, deposited by the streams along with colluvium eroded from the valley walls and upland areas. The second major source is glaciolacustrine deposits that were formed in bodies of relatively stagnant lake water, and are marked by soft silt and clay. These lake deposits were formed when the Ohio River valley was choked with coarser material carried by glacial meltwater. Thick deposits of this material effectively dammed tributary streams, creating lakes. Thick deposits of silt and clay, sometimes called “slackwater clay,” mark the former locations of these glacial lakes. These lacustrine deposits are often noted on Quaternary geology maps and soil maps. They can occur up to an elevation of about 500 feet m.s.l. in the county. They are especially noted near Brooksburg in the valley of Indian Kentuck Creek.

There are areas in this aquifer system where the thickness of unconsolidated materials approaches 100 feet. This is true for the downstream portions of the areas where this system joins the Ohio River Outwash Aquifer System. Farther upstream, particularly along Indian Kentuck Creek, the thickness rapidly decreases to perhaps 25 feet or less. It is expected that most wells drilled in the mapped aquifer system will be adequate for domestic needs. However, because the water-bearing materials in these valleys typically become thinner and finer grained upstream, only near the gradational contact with the Ohio River Outwash Aquifer System could higher capacity wells be expected. In areas where the aquifer system is thin, and where only fine-grained sand and silt are present, large-diameter bored (bucket-rig) wells could be employed where conventional drilled wells would not be successful. Overall, prospects for completing domestic wells range from good to excellent, but prospects for high-capacity wells are poor in most areas.

This aquifer system is generally marked by thick surface deposits of soft silt and clay that have low susceptibility to surface contamination. However, the surface cap of silt and clay may thin substantially in some of the upstream areas so that the aquifer system would have a moderate susceptibility to surface contamination.

Pre-Wisconsin Drift Aquifer System

The Pre-Wisconsin Drift Aquifer System occurs in the northwestern part of Jefferson County. The system is discontinuous, occurring as individual areas within a larger area in southern Indiana covered by pre-Wisconsin till and other glacial deposits. The system is typically found on scattered upland areas where glacial drift ranges from about 50 to 80 feet in thickness. Boundaries with other aquifer systems, particularly the Dissected Till and Residuum Aquifer System, are gradational. Some of the aquifers within the two systems are similar in their origin and placement, but differ in thickness and extent.

The Pre-Wisconsin Drift Aquifer System is composed primarily of glacial tills that contain intratill sand and gravel aquifers of limited thickness and extent. The grain size of aquifer materials in the intratill deposits varies locally and ranges from fine or muddy sand to coarse gravel. Sand and gravel lenses within the system may range in thickness from about 1 to 20 feet, but are commonly less than 10 feet thick. Well depths in this aquifer system are variable and are influenced by bedrock elevation and the depth to productive sand and gravel layers within the thicker tills. The one location-verified well record on file at the Division of Water shows a well depth of 68 feet. The reported static water level was 20 feet below land surface. A pumping rate of 60 gpm was sustained for 9 hours.

Well yields in the Pre-Wisconsin Drift Aquifer System would be expected to be quite variable, but generally adequate for domestic use. However, because sand and gravel aquifer zones are not very thick in much of this aquifer system, large-diameter bored wells may be used to increase yield. The large diameter of such wells permits them to store water from thin sand zones or as seepage from fractures within the till.

The Pre-Wisconsin Drift Aquifer System has a low susceptibility to surface contamination because intertill sand and gravel units are generally overlain by several feet of low-permeability glacial till.

Ohio River Outwash Aquifer System

The Ohio River Outwash Aquifer System occupies the main valley of the Ohio River. This valley carried great quantities of outwash from the melting glaciers during Wisconsin and pre-Wisconsin glacial periods. However, only pre-Wisconsin ice sheets actually covered Jefferson County.

This aquifer system contains large volumes of sand and gravel that fill the main river valley. As the glaciers melted, the sediment contained within them was delivered to the Ohio River in quantities too large for the stream to transport. As a result, the increased sediment load was stored in the valley as vertical and lateral accretionary deposits. As long as the retreating

glaciers continued to provide sediment in quantities too large for the stream to transport farther downstream, the valley continued to be filled. This valley-filling process formed the most prolific aquifer system in the county.

Unconsolidated deposits of the Ohio River Outwash Aquifer System range from about 40 feet to 150 feet in thickness. This aquifer system, with its thick sand and gravel, contrasts sharply with the adjacent Dissected Till and Residuum Aquifer System, which has practically no sand and gravel. However, not all of the unconsolidated deposits are saturated with water. Actual aquifer thickness (saturated sand and gravel) of the Ohio River Outwash Aquifer System ranges from about 7 to 83 feet, but most of the system has an aquifer thickness between 40 and 70 feet. Static water levels typically range from about 35 to 55 feet below land surface. Because water levels in some places are near the base of an overlying fine-grained clay, silt, or muddy sand the aquifer could be under confined or unconfined conditions.

The elevations of high terraces in the Ohio River valley range from approximately 480 feet m.s.l. upstream where the river enters southeastern Jefferson County and approximately 470 feet m.s.l. downstream where it leaves the county. Accurate elevations of the top and bottom of the aquifer itself are hard to determine because there are not many records available for wells completed in the aquifer. However, several records show 10 to 45 feet of clay or muddy sand and silt above the aquifer. The bottom elevation of the aquifer is expected to range from about 340 to 300 feet m.s.l. in that part of the valley where the depth to bedrock is greatest.

The Ohio River Outwash Aquifer System is by far the most productive aquifer system in the county and has the potential to consistently meet the needs of high-capacity water users. Large-diameter well yields of 300 to 2100 gpm have been obtained in this system. Ten registered significant ground-water withdrawal facilities currently use (or did use) this aquifer system in Jefferson County. The system could support considerably more development.

This aquifer system is highly susceptible to contamination from surface sources in areas that lack overlying clay layers. The system is only moderately susceptible where it is overlain by thick clay or silt deposits.

Registered Significant Ground-Water Withdrawal Facilities

Jefferson County has several registered significant ground-water withdrawal facilities that tap the prolific Ohio River Outwash Aquifer System. They include public water supplies for the city of Madison and other utilities serving Hanover and rural customers located over much of the county. Additionally, some irrigation and industry supply wells use the same aquifer. Refer to Table 1 for more details on the wells and to the map for facility locations.

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